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SOLUTION BY J. L. RILEY, Stephenville, Texas.

Evaluating the first determinant, we have $[R(R - 2ay^2 - 2bu^2)]^2$, where

$$R = x^2 + ay^2 + bu^2 + abv^2.$$

The second determinant, when expanded, gives $a[-2R(xy + buv)]^2$; the third gives $b[2R(avy - ux)]^2$; the fourth gives 0; and the fifth determinant gives $[-R^2]^2$. But

$$[R(R - 2ay^2 - 2bu^2)]^2 + a[-2R(xy + buv)]^2 + b[2R(avy - ux)]^2 + [-R^2]^2$$

unless $(ay^2)(bu^2) = 0$. Hence the relation stated in the problem does not always hold.

520 (Geometry). Proposed by ALBERT A. BENNETT, University of Texas.

On a given tangent to a circle determine a point such that, if a secant be drawn joining this point to the extremity of the diameter which is perpendicular to the given tangent, the segment of this secant exterior to the circle will be equal in length to a given segment.

SOLUTION BY A. M. HARDING, University of Arkansas.

Let us denote the radius of the given circle by r and the length of the given segment by $2d$. Let AB be the diameter perpendicular to the tangent at the point of tangency A . Take a length $AC = d$ along the tangent from A . Join BC . Take D on CB so that $CD = d$. With center at B draw arc DE cutting the circle at E . Produce BE to cut the tangent at P . Then P is the required point.

Proof:

$$BE = BD = \sqrt{d^2 + 4r^2} - d.$$

Since AE is perpendicular to BP it follows that

$$AB^2 = BE \times BP = BE(BE + EP).$$

Hence,

$$4r^2 = (\sqrt{d^2 + 4r^2} - d)(\sqrt{d^2 + 4r^2} - d + EP).$$

From this equation we find

$$EP = 2d.$$

Note: If a point Q be taken on the tangent such that $AQ = AP$, this point Q will also satisfy the conditions of the problem.

Also solved by MAY PHALOR, H. T. AUDE, HERBERT N. CARLETON, OSCAR S. ADAMS, H. C. FEEMSTER, and PAUL CAPRON.

521 (Geometry). Proposed by R. M. MATHEWS, Riverside, Cal.

A variable circle, with center on the line l and passing through a fixed point P , cuts a fixed circle in A and B . Prove that the common chord AB and the perpendicular to l through P intersect in a fixed point.

SOLUTION BY L. E. MENSENKAMP, Freeport, Illinois

It is convenient to employ rectangular coördinates. Let l be taken as the axis of x and the point P on the y -axis; then the perpendicular to l through P is the axis of y . Under these conditions, it follows from elementary analytic geometry that the equation of the variable circle is

$$(x - \alpha)^2 + y^2 = r^2,$$

where r is the radius of the variable circle. The equation of the fixed circle may be taken as

$$(x - a)^2 + (y - b)^2 = c^2.$$

Subtracting the first equation from the second, we get

$$2(\alpha - a)x - 2by = c^2 - a^2 + \alpha^2 - r^2 - b^2,$$